

THE PROBLEM OF AN ULTRA-NEPTUNIAN PLANET.

IN this memoir¹ Prof. W. H. Pickering first gives a graphical method by which Neptune might have been discovered from the data used by Le Verrier and Adams. Having thus demonstrated the practical value of his method, he proceeds to apply it to a search for a planet beyond Neptune. He calls his hypothetical planet by the letter "O," obviously as the next letter of the alphabet to the initial of Neptune, and he finds, *inter alia*,

Mean distance	...	...	...	51.9
Period	...	...	...	373.5 years
Mass	...	...	= twice that of the earth	
R.A. in 1909.0	...	...	...	7h. 47m.

Now the problem presented by Uranus, Neptune, and "O" may be very readily reduced to the known problem, already fully worked out, of Mercury, Venus, and the earth, for it is easy to show that the theory of a pair of planets is the same if we retain the masses but alter the distances of both in the same proportion.

First of all, as, roughly speaking, we are only able to observe heliocentric longitudes of Uranus and Neptune, we must suppose that our fictitious observer, to whom the existence of the earth is unknown, is only able to observe heliocentric longitudes of Mercury and Venus. We may speak of him, therefore, as an observer in the sun.

Secondly, as the mass of "O" is twice that of the earth, we must credit the observer in the sun with instruments of twice the precision of those used by ourselves.

Lastly, we may divide all distances by 51, and all time intervals by 365. This latter factor enables us to substitute days for years.

We are, therefore, to suppose that an observer in the sun, with instruments of twice the accuracy of our own, has observed Mercury for four months and Venus for two months, and that in addition he has one or two stray observations of Mercury and Venus made before he recognised its planetary character.

Now let us turn to the tables of Mercury and Venus, and estimate for ourselves what chance such an observer has of demonstrating the existence of the earth.

Before doing this, however, we must pause for a moment in order to show that we may dismiss from notice all long-period terms. These terms play a very conspicuous part in planetary theory. Their existence depends upon the same principle as that of the swing, where a very small force applied at regular and suitable intervals will produce very large oscillations. Their existence necessitates the expansion of the disturbing function to ten or a hundred times the accuracy otherwise necessary, and the consequence is that from the computer's point of view the short-period terms are dismissed with scanty notice in the account that he gives of his work.

For example, in the heliocentric longitude of Venus there is a term

$$3'' \sin (13E - 8V)$$

with a period of 239 years. Our hypothetical observer in the sun would have no chance of detecting such a term as this. If he detected in two months' observations any term at all it would be one of the following:—

$$\begin{aligned} &5'' \sin (V - E) \\ &11'' \sin 2(V - E) \\ &7'' \sin 3(V - E) \end{aligned}$$

the periods being 585, 292, and 195 days respectively.

¹ "Annals of the Astronomical Observatory of Harvard College." Vol. Ixi., part ii. A Search for a Planet beyond Neptune. By W. H. Pickering. (Cambridge, Mass.: The Observatory, 1909.)

It may further be observed that it is the long-period terms which are largely affected by small changes in the elements of the disturbing planet; the short-period terms are not appreciably affected. During the hypothetical two months of observation the question is, "Where is the disturbing planet at that time?" not "Are the elements such as produce a long-period term?"

Further, it is not sufficient that a term of moderate amplitude and period should exist. In the hypothetical two months, only a very small portion of a complete period is observed, and the conditions must be such that the term is not mistaken for uniform motion or for a term periodic in the period of the planet under observation, for in either case the term could be represented by a change of the elliptic elements of the orbit.

At this point we wish to say that we do not think Prof. Pickering's case is a good one, and, having thus proclaimed ourselves adverse critics, we wish immediately to concede the following point. In our opinion the hypothetical observer could detect from two months' observations the term $7'' \sin 3(V - E)$ in the heliocentric longitude of Venus, and could distinguish it from a mere error of assumed elliptic elements, provided only the phase of the argument happened to be suitable during the period of observation. Reverting now to the actual case, the existence of planet "O" could be demonstrated from the observations of Neptune at the present date if the epoch of planet "O" were suitable. If the observations of Neptune show nothing, the hypothesis of the existence of "O" would not be negatived, but the hypothetical "O" would at least be confined to certain limits of longitude.

Prof. Pickering, however, has based his discovery of "O," not on Neptune, but on Uranus. In the hypothetical case we have to consider the perturbations of Mercury by the earth. In this case we have terms such as

$$\begin{aligned} &0.2'' \sin (M - E) \\ &0.3'' \sin 2(M - E), \end{aligned}$$

which we believe to be quite incapable of detection from four months' observations, or at any rate of detection and distinction from elliptic terms. In saying this we do not forget that the terms must be doubled to take account of the double mass attributed to "O."

It will be seen that our criticisms are directed against Prof. Pickering's figures as we find them. We have argued against the extremely small mass assigned to the hypothetical planet, seeing that Prof. Pickering's data are the observations of Uranus. While constructing our argument we have, however, convinced ourselves that the time is ripe for a discussion of the observations of Neptune, for if the planet "O" exists, or any approximation to it, it should have produced, or at any rate should soon produce, a visible effect on Neptune.

NOTES.

MEETINGS of two special commissions appointed by the International Meteorological Committee at Paris in 1907 will be held in London during the week commencing Monday next, June 21. The appointment of the first commission arose out of a proposal made at Innsbruck by the Rev. Louis Froc, S.J., director of the Zi-ka-wei Observatory, for the general adoption of a code of maritime weather signals now in use in far eastern waters, and a further proposal made at Paris by Prof. Willis Moore, chief of the United States Weather Bureau, in favour of an international system of maritime weather signals. To

this commission the question of an understanding as to the projection and scale of charts for representing marine meteorological data was also referred. It is expected that M. Angot, director of the Bureau Central Météorologique of Paris; Father Froc, of Zi-ka-wei; Prof. Grossmann, representing Rear-Admiral Herz, director of the Deutsche Seewarte, who is prevented by illness from attending; Prof. Mohn, director of the Meteorological Institute, Christiania; and Prof. Willis Moore, will be present to take part in the meetings. The second commission is appointed to consider international questions concerning weather telegraphy, including wireless telegraphy from ships. The members to be present are Messrs. Angot, Grossmann, and Willis Moore. Both commissions are under the presidency of the director of the Meteorological Office, and the meetings will take place at the office. The commissions will report to the meeting of the International Meteorological Committee which is expected to be held in 1910. Some of the visitors will remain to take part in the meetings of the Solar Commission during the week beginning June 28.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Wednesday, June 30.

THE death is announced, in his sixty-sixth year, of Prof. Carl N. I. Börgen, for thirty-four years director of the Imperial Observatory at Wilhelmshaven.

THE Prince of Wales will attend the meeting of the Royal Geographical Society at the Albert Hall on June 28 for the reception of Lieut. E. H. Shackleton, and will present to Lieut. Shackleton the special gold medal awarded to him by the society.

THE Pharmaceutical Society has awarded the Hanbury gold medal to Prof. W. O. A. Tschirch, professor of pharmacognosy and practical chemistry at Berne University. The medal is awarded biennially for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs.

WE have been favoured with a copy of the *Sydney Daily Telegraph* of April 29, containing an interesting account of the inaugural meeting of the Aërial League of Australia, at which Mr. L. Hargreave, the inventor of the box kite, presided. The objects of the league are, among others, to watch the latest achievements in aërial engineering; to secure the best recognition for Australian efforts in that direction; and to awaken public attention to the danger in allowing foreign nations to excel in aërial navigation.

THE Constantinople correspondent of the *Times* reports that a proposal, brought before the Chamber of Deputies on June 12, for the adoption of the system of time-reckoning used in Europe, instead of the Turkish system of reckoning time from the hour of sunset, was carried, in spite of the opposition of the *hodjas* and many Anatolian deputies, by a considerable majority, including the Arabs. But the clerical minority in the Chamber has made such an uproar that the motion has since been withdrawn.

THE council of the Royal Institute of Public Health has awarded the Harben gold medal for eminent services to the public health to Prof. E. von Behring, Marburg. Lieut.-Colonel W. B. Leishman, professor of pathology, Royal Army Medical College, has been appointed the Harben lecturer for the year 1910, and Prof. Angelo Celli, Rome, the Harben lecturer for the year 1911. The Harben lectures for 1909 will be delivered by Prof. R.

Pfeiffer, Breslau, in the lecture-room of the institute on June 21, 23, and 25. The subjects of the lectures will be:—the importance of bacteriolytins in immunity; endotoxins and anti-endotoxins; and the problem of virulence. The lectures will be given in English.

WE learn from *Science* that Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory, has left Washington for Mount Wilson, California, to continue observations, in progress for a number of years, as to the intensity of the sun's rays and the effect of any variation in them upon the earth. There was recently erected on Mount Wilson a small permanent observatory especially designed for this purpose. Here Mr. Abbot, with the assistance of Dr. L. R. Ingersoll, of the University of Wisconsin, will study during the next few months. The expedition will also spend some time on the summit of Mount Whitney, 14,500 feet high, where the institution proposes to erect in July a shelter of stone and steel for the use of scientific investigators engaged in researches of any kind for which high altitudes, dry air, and clear skies are desirable.

THE famous Hope diamond was on view last week at Messrs. R. and S. Garrard's galleries, Haymarket, London, S.W. Its history has been romantic. It probably formed the larger half of the pear-shaped, Indian stone, which was stolen with the remainder of the French regalia at the time of the Revolution in 1792, and never recovered. In its present form it re-appeared in the collection of Henry Philip Hope, a wealthy banker. At his death it found its way to America, and last year, during the financial crisis, the owner disposed of it to M. Habib, a dealer, who was acting on behalf of the late Sultan of Turkey. Owing to the deposition of that monarch, the stone has come into the market once more. In the catalogue of the Hope collection it is described as of a sapphire-blue, but a slaty- or steely-blue would be more the correct description. It weighs $44\frac{1}{2}$ carats, and is by far the largest blue diamond known.

A SEVERE earthquake was experienced at many places in southern France at about 9.15 p.m. on June 11. From a full report by the Paris correspondent of the *Times* it appears that the shock was felt all along the French Mediterranean shores. On the coast it was most violent at Marseilles and Toulon. At Nice and at Cannes a shock was experienced, but it was not severe. More or less slight shocks were felt through the south-east of France from Montpellier to Grenoble and from Perpignan to Avignon. Telegrams from the Italian Riviera, on the one hand, and from Portugal, on the other, show that the shock was felt in regions so widely apart as these. The region most seriously affected by the earthquake is between Aix-en-Provence, a town about twenty miles north of Marseilles, and the River Durance, the northern boundary of the department. The line of greatest destruction seems to run in a north-westerly direction from Aix through the villages of Saint-Cannat, Lambesc, and Rognes.

A SHORT account of the inauguration, on June 13, of the memorial to Lamarck, which has been erected in the Jardin des Plantes, is given by the Paris correspondent of the *Times* in the issue of June 14. The memorial was formally inaugurated in the presence of M. Fallières, and was committed to the charge of the French Government. It takes the form of a bronze figure of Lamarck seated in an attitude of meditation. Inscribed on the pedestal are the words, "To the founder of the doctrine of evolution." The *Times* says that in his speech M. Perrier

traced the various stages of the development of Lamarck's theory, its relation to the studies of Buffon, Linnæus, and Cuvier, and its influence upon Darwin. The present year is at once the hundredth anniversary of the publication of Lamarck's "Philosophie Zoologique" and of Darwin's birth, and in a striking passage M. Perrier drew a parallel between the Darwinian theory and Lamarck's doctrine of methodical progress on a basis of rigorous determinism. The Minister of Public Instruction contributed to the proceedings a sketch of Lamarck's career, referring to Buffon's sympathy and friendship and to Cuvier's sceptical hostility. In the name of the French Government, M. Doumergue thanked all who had helped France to make this tardy reparation to the memory of her great son.

THE launching of the magnetic survey yacht *Carnegie*, to the design and future work of which reference has been made more than once in these columns, took place on June 12 at the shipyard of the Tebo Yacht Basin Company, Brooklyn, N.Y. We have been favoured with an advance copy of an illustrated pamphlet dealing with the construction of the new boat, her object, and her work. The entire structure of the yacht is practically non-magnetic; with the exception of cast-iron pistons in the cylinders of the bronze internal-combustion engine, and the steel cams necessary for operating the valves, there are no magnetic materials in the vessel. It will be remembered that the function of the department of research in terrestrial magnetism of the Carnegie Institution of Washington is the accomplishment of a magnetic survey of the earth within a period of about fifteen years, and in connection with this scheme the magnetic survey of the oceans is assigned to the new yacht. This work will be done under the direction of Dr. L. A. Bauer, director of the department of terrestrial magnetism, and he will be represented on board the *Carnegie*, as chief of party, by Mr. W. J. Peters, who has great experience in such ocean surveying, gained when in command of the magnetic survey yacht *Galilee* from 1906-8. The *Galilee* has made a general magnetic survey of the Pacific Ocean, the total length of her cruises amounting to about 60,000 nautical miles. It is hoped that the *Carnegie* will effect a magnetic survey of the Atlantic Ocean and the Indian Ocean, and complete that of the Pacific.

WE have received a copy of a paper by Drs. Raymond Pearl and F. M. Surface, reprinted from the first volume of *Zeitschrift für biologische Technik*, Strassburg, 1909, and entitled "Apparate und Methoden, die bei experimentellen Untersuchungen über Vererbung beim Geflügel gebraucht werden."

THE Insectivora of the subfamily Gymnurinæ form the subject of a paper by Mr. M. W. Lyon, published as No. 1680 (vol. xxxvi., pp. 449-56) of the Proceedings of the U.S. National Museum. The author admits the distinction of the Bornean *Gymnura alba* from the typical *G. rafflesii* (or *G. gymnura*), and also describes a new and small race of the latter from Siam. The distinctive skull-characters of the allied genera *Hylomys* and *Podogymnura*, the latter at present known only by a single specimen from the Philippines, are likewise pointed out.

THE May number of the *Museums Journal* contains an account, by Mr. R. T. Baker, the curator, of the Technological Museum at Sydney. The building, which was opened in 1893, contains considerably more than 150,000 specimens, and the establishment serves the purpose of a bureau of information in regard to the raw products and manufactures of New South Wales. When inquiries can-

not be answered by the museum staff, visitors are referred to other sources of information.

IN vol. xlv., No. 23, of the Proceedings of the American Academy of Arts and Sciences, Mr. S. Morgulis describes the capacity for regeneration possessed by one of the brittle-stars (*Ophiocoma pumila*), with special reference to the influence of the central nervous system. Although the author's experiments do not altogether support the theory that the rate of regeneration of a removed arm increases as the number of uninjured arms still remaining is diminished, it is, nevertheless, evident that there is some correlation between the degree of injury and the rate of regeneration, but this relation does not take the shape of the close parallelism suggested in the above-mentioned theory.

AN account of the myxomycetes of Pictou County, Nova Scotia, by Mr. C. L. Moore, published in the Transactions of the Nova Scotia Institute of Science (vol. xii., part ii.), furnishes a noteworthy addition to the information on this little-studied group of fungi, as well as an interesting contribution to the flora of the country. In the latter respect, the diagnoses of the groups, genera and species will be found useful. One specimen, collected on *Tsuga canadensis*, is made the type of a new species, *Margarita pictoviana*. *Dictydium cancellatum* is stated to be the most general species, and others commonly found are *Fuligo ovata*, *Didymium melanospermum*, *Arcyria nutans*, *Arcyria incarnata*, and *Lycogala epidendrum*.

THE Nyctaginaceæ provides an eminently fitting subject for the Contributions of the United States National Herbarium (vol. xii., part viii.), as the family is very largely American, and the group Mirabilieæ is essentially characteristic of Mexico and the adjacent southern States. This group is monographed by Mr. P. C. Standley, who adopts Allioniaceæ as the family name. The changes and additions submitted are very extensive. About twenty new species are proposed for the genus *Abronia*, from which the section *Tripterocalyx* is separated as a genus. *Allionia*, based on the species *Allionia violacea*, is converted into a large genus, partly by the inclusion of species of *Oxybaphus* and partly by additional new species. *Mirabilis* is reduced to four species, while *Quamoclidion* becomes a genus; similarly, *Boerhaavia* is split into four genera.

THE beautiful autumnal tints characteristic of the foliage of certain trees and shrubs, so pronounced in temperate countries, are, of course, due to seasonal variations, the factors concerned being diminution of water, stronger insolation, and the advent of cold nights; also, the more marked the changes the more striking, as a rule, are the colour tones. In a short article in the Journal of the College of Science (vol. xxvii., art. 2), Tokio University, Dr. M. Miyoshi refers to a similar colour effect observed during the dry period in the leaves of the tropical tree *Terminalia catappa*. Here it is confined to the old leaves, while the younger leaves show their normal green colour, and is due to drying up of the leaves owing to the formation of an absciss layer. In both cases the colour is produced by the formation of anthocyanin.

DR. GRASSET publishes in the May number of *La Revue des Idées* an elaborate article entitled "La Physiopathologie clinique de l'Homme, Plan d'une Pathologie générale basée sur la Physiologie." The "circle of life" starts with general embryology and heredity, and passes on in succession to "fonctions de réception" (digestion and respiration); "fonctions de circulation de la matière"

(blood and lymph); "fonctions de l'élaboration" (nutrition); "fonctions d'élimination de la matière" (external secretions); "fonctions de calorification" (production, transformation, and elimination of heat); "fonctions de réception, élaboration, et élimination de l'énergie"; "fonctions antixéniques" (protection of the organism against what is noxious in the environment); and, finally, "fonctions de reproduction." The scheme is certainly ingenious, and gives a good illustration of the methods of logical analysis for which science in many of its departments is so largely indebted to the savants of France.

In *Naturwissenschaftliche Wochenschrift* for May 23 Dr. Ludwig Reinhardt gives an illustrated account of a human skeleton discovered on April 10, 1908, in the well-known cavern of Le Moustier, in the Dordogne, in a stratum lying some 30 feet below the one worked years ago by Lartet and Christy. The latter stratum is assigned to the Neanderthal period, but the new "find," from the evidence of the associated implements, is identified with the earlier Acheuleen (St. Acheul) epoch. An age of some 400,000 years is assigned to the deposit in question, which belongs to the penultimate inter-Glacial epoch; the Le Moustier hunter, for whom the name *Homo mousteriensis hauseri* has been proposed by Prof. Klaatsch, representing the oldest human skeleton at present known. The skull was greatly damaged when discovered, but has been carefully pieced together, while the bones of the skeleton have been freed from matrix and placed in their proper positions. The remains indicate a young man of between sixteen and eighteen years of age. The limb-bones are relatively short and thick, the cranial portion of the skull is markedly receding, while the jaws are very protruding, after a fashion occasionally met with among modern Australians. Associated with the ape-like muzzle is an extremely powerful dentition, the individual teeth having much stouter roots and more enamel-folds than in any living race. Among other characters of the skull, it must suffice to mention the large size and wide separation of the orbits, and the broad and deeply sunk root of the nasals, the latter feature indicating a wide and flattened nose, with the nostrils directed mainly forwards. Whether the shape of the skull has been altered by the restoration has to be taken into consideration.

In the third Bulletin of the Archæological Survey of Nubia Dr. G. A. Reisner describes the excavations conducted up to the close of 1908, and Drs. G. Elliot Smith and Douglas E. Derry review the anatomical results. The excavations supply further evidence in support of the views advocated in the previous reports. In pre-dynastic times, and up to the third Egyptian dynasty, this part of Egypt and Nubia formed a territory occupied by a homogeneous race which was Egyptian, and not Nubian, in physical type and culture. This disposes of the theory that the archaic Egyptians contained a strong negro element. Since the rise of the third dynasty there has been a continuous intermixture of Egyptian and negro strains. Negroes seem to have moved north when the seat of Egyptian government was moved from Upper to Lower Egypt, and the hold of the Empire upon Nubia was probably relaxed. After that time both races were reinforced by fresh emigrants, but the fusion was gradual and continuous. In the time of the New Empire, doubtless owing to Hyksos domination, refugees flocked southwards and formed connections with Nubian women, individuals of both races of different sexes being found in the same grave. The question of the existence of tuberculosis in ancient times is again raised by Dr. Derry. The

case reported in the first bulletin was discredited, but since then the body of a priest of Amen belonging to the twenty-first dynasty, found at Thebes, shows angular curvature of the spine and a psoas abscess, which are diagnosed as evidence of Pott's disease. If the disease prevailed at Thebes in the New Empire, it is not improbable that the Nubian cases of the Middle Empire may be of a similar character.

THE *Bolletino della Società Sismologica*, vol. xiii., No. 4, contains an important paper, by Prof. Grablovitz, on the secondary oscillations recorded by the tide-gauge at Ischia. The period of these is found to have varied considerably during the last nineteen years, from a maximum of 14m. 19s. in 1892 to a minimum of 11m. 55s. in 1908; as a rule, the variation is slow, and the period remains constant for a considerable time, but at times it changes rapidly. During 1897, for instance, the period fell from 13m. 45s. to 12m. 34s., and in 1902 it dropped from 14.1m. on January 8 to 13.2m. on March 30, rose again to 14.1m. on April 26, fell to 13.0m. on May 14, and rose again to 14.3m. by May 27. Accepting the explanation that the period of these secondary undulations is the natural period of oscillation of the water, and is, consequently, a function of the dimensions of the basin, he shows that, as there has been no known alteration of the coast-line adequate to account for the observed variation in period, this explanation necessitates the assumption of variations in depth. Some facts are quoted which show that such changes may well have occurred, but it is also pointed out that the variations in period may be directly connected with the action of the exciting cause, and not entirely determined by resonance.

THE report of the Southport Meteorological Observatory for the year 1908 has been received. This station occupies an important position in the Irish Sea, and is kept in great instrumental efficiency by the Corporation, the practice being to employ continuously two self-recording instruments for each of the principal elements. The observatory also maintains two subsidiary stations—Marsh-side, a mile to the N.N.E., for additional anemometrical observations, and an evaporation station at Barton Moss, about 5½ miles to the S.S.W. Regarded as a whole, the year was decidedly warm and the rainfall normal (32½ inches); there was a predominance of south-easterly winds quite unequalled in any other of the thirty-seven years over which the record extends. The report includes a useful comparison of sunshine and other climatological statistics at sixty-three health resorts and large towns, all of which have been checked by either the Meteorological Office or the Royal Meteorological Society.

THE *Revue générale des Sciences* of May 15 contains an important article, by Prof. B. Brunhes, on "The Evolution of Barometric Depressions and M. Guilbert's Rules for Weather Prediction," illustrated by weather charts. The article is, in fact, the preface to a work which is about to be published by M. Guilbert entitled "New Method of Weather Forecasting." Eighteen years ago M. Guilbert, who is now secretary of the meteorological commission of the department of Calvados, communicated certain rules to the Meteorological Society of France; these have since been developed, and have attracted more general attention in consequence of his success at the international competition in weather forecasting in connection with the exhibition at Liège in 1905. The rules have since appeared in several meteorological periodicals, including the *U.S. Monthly*

Weather Review, and the method was referred to by Dr. Shaw at the British Association meeting of 1907, who explained that it "depends upon the comparison of the actual winds, as recorded on the map, with ideal or normal winds as computed from the distance apart of the consecutive isobars." Prof. Brunhes discusses at great length both the rules and the objections that have been raised against them. He thinks the principal questions now are:—(1) whether the method of forecasting, which in the hands of M. Guilbert gives such surprising results, can be formulated in a way which may obviate objections to his exposition; and (2) whether the principles can be so enunciated that other meteorologists may attain the same success. To the first question he gives a decided affirmative, but to the second the reply is more reserved; the publication of the work, which has been urged by M. Teisserenc de Bort and himself, is an effort to hasten the solution of these questions.

WE have received a new catalogue of physical and electrical instruments, balances, &c., from Messrs. W. G. Pye and Co., of Granta Works, Cambridge. We note that a considerable number of pieces of apparatus have been designed by Mr. G. F. C. Searle, F.R.S., of Cambridge. This kind of cooperation between the maker and user of scientific apparatus is much needed, and will, we believe, result in a great improvement in the utility and accuracy of the instruments made in this country.

THE question whether intermolecular radiation would account for any appreciable fraction of the heat transmitted through a metal owing to temperature differences existent in it has often been discussed. Several years ago Riecke showed that the part contributed by radiation must be excessively small. His calculations were, however, based on an equation given first by Sampson and afterwards by Schuster, which Königsberger showed was not accurate. In the *Physikalische Zeitschrift* for May 15 Dr. M. Reinganum takes up the question again, and, basing his investigation on the radiation work of Planck and on the law that the intensity of radiation in a medium of index of refraction n is n^2 times that in the ether in equilibrium with it, he arrives at the conclusion that in silver and in zinc radiation will not account for more than one-millionth part of the heat transmitted. In alloys it is still far below the order of magnitude of the conduction. In all electron theories of conduction it may therefore be entirely neglected.

EASEMENT curves form the subject of an interesting article, by Prof. R. H. Smith, in the *Engineer* for June 4. The term "easement" indicates a curve which can be turned without damaging collision, without the fury of whirlpool motion in fluids or of hard knocks between solid members. Within elastic limits, a heavy stress steadily maintained does no harm. The damaging intensity of a blow is proportional to the time rate at which the stress increases. When the stress is produced by curvature in the motion path, the author shows that the intensity of the radial shock is proportional to the product of the cube of the velocity and the rate of change of the curvature with respect to length measured along the path. In proportion as the cube of the velocity is high, the rate of change of curvature should be low. Hence the importance of examining different forms of easement curves in respect of this purely geometric characteristic. The author discusses mathematically curves shaped to the equation $y = Kx^m$, where m is any index. The time rate of increase of radial stress should be little or nothing at first, and should gradually increase up to the unavoidable amount.

It starts with zero if m be anything greater than 3, but the most satisfactory result is not obtained with m less than 4. Of all this class of easement curves, the bi-quadratic parabola is the best.

IN several notices and reviews it has been pointed out that the experimental study of flow of air past resisting bodies not only was of importance in connection with aviation, but might also have valuable applications to the problem of dust formation in the wake of motor-cars. At that time it was not known to the writer of the notices that the matter was receiving attention. A paper by Mr. W. R. Cooper, read before the Royal Automobile Club on May 18, shows that automobilists have not been so behindhand in appreciating scientific methods as was supposed. Indeed, experiments involving photography of dust clouds were described in the *Automobile Club Journal* so far back as December, 1905, and an account of them appeared in *NATURE*. Mr. Cooper now describes a recording apparatus with which he has studied the direction of the stream lines in the neighbourhood of the car. It consists essentially of a small vane at the end of a bamboo rod, which can be moved about behind or in front of the car, the vane being connected by pulleys with a pointer inside the car. An apparatus for measuring air pressures is also described. Mr. Cooper is to be congratulated on the progress he has made, and though there are still many difficulties to be overcome, there is no doubt about the practical value of these researches.

AN American edition of Mr. R. C. Punnett's little book on Mendelism has been published by the Wilshire Book Co., of New York. The new edition is provided with a preface by Mr. Gaylord Wilshire, in which he deals with the sociological significance of the Mendelian theory.

MESSRS. MACMILLAN AND CO., LTD., now publish the well-known book by the late Prof. A. Milnes Marshall, F.R.S., on "The Frog." The volume, which, it will be remembered, is an introduction to anatomy, histology, and embryology, has been edited by Dr. F. W. Gamble, F.R.S., and has now reached its tenth edition.

A CATALOGUE of books on astronomy, mathematics, and physics, consisting mainly of important works purchased recently from several private libraries, has just been issued by Mr. Bernard Quaritch, 11 Grafton Street, New Bond Street. The price of the catalogue is one shilling.

DURING the seventh International Congress of Applied Chemistry, held recently in London, photographs of four-teen groups of the various sections were taken by the Dover Street Studios. Prints of these groups have been sent to us, and one of them, reproduced in a reduced form, accompanies the general article upon the scientific proceedings of the congress which appears elsewhere in this issue. We are informed that the photographs are to be published in complete album form at the price of four guineas, or they may be had separately.

A SECOND edition of "Sanitary Law and Practice: a Handbook for Students of Public Health and Others," by Drs. W. Robertson and Charles Porter, has been published by the Sanitary Publishing Co., Ltd. The original issue of the work was reviewed in *NATURE* of June 1, 1905 (vol. lxxii., p. 97), and it is sufficient to state here that much new matter has been added to the volume, and the former text completely revised and in many instances re-written. Among the new sections, those on school medical inspection and vital statistics may be mentioned. The size of the print has been reduced slightly, and the price remains at 10s. 6d. net.